Marbled Murrelet Effectiveness Monitoring
Population Team Meeting March 1-2, 2000

In Attendance:

Jim Baldwin	C.J. Ralph
Naomi Bentivoglio	Marty Raphael
Tim Max	Craig Strong
Sherri Miller	Chris Thompson

<u>Overview</u>
The team came to agreement about various aspects of a population sampling design including standardized survey methods. We consider the upcoming field season to be a pilot year. These notes will be the basis for a Marbled Murrelet Population Monitoring Program (Program) to meet the needs of Northwest Forest Plan Effectiveness Monitoring. NB will write up the Program for the group to edit.

SAMPLING DESIGN
<u>Target Population</u>
The Northern border is the Canadian border and the Southern border is approximately San Francisco Bay (See Summary Sampling Design Table below. We will also develop maps.). Note that Marbled Murrelet Conservation Zone 6 is outside the Forest Plan area and therefore outside the target population. However, this area could easily be included into this sampling design.

The near shore boundary is roughly the shoreline, surf line, or kelp line which equate to safely navigable waters. This distance will be gathered for each primary sampling unit.

The offshore boundaries vary in different areas. Do we foresee a consistent long term increase of birds offshore of our outer boundary? No. However, if evidence starts to suggest that may be happening, we will have to add another offshore strata. The Program will include our rationale for our distances offshore with caveat language for adding another strata if need be. For example, one rationale for offshore distances is bathymetry and our understanding of the associated murrelet prey species and foraging opportunities.

<u>Time of Year</u>
We chose the time of the year generally associated with breeding birds taking into account some of the phenology shifts up and down the coast. This may change depending on decisions about whether and how to incorporate productivity into the Program

<u>Stratification</u>
Within the Forest Plan area, there are 5 conservation zones. We will obtain separate population estimates and trends for each zone. Within each zone, researchers identified geographic areas of different densities along the coast. These areas are geographic strata within the zones. Assumption: Some minimal level of sampling must happen within each strata with the lower

density strata receiving less sampling effort.

We will not make a separate population inference for each geographic strata during the pilot year. However, we will develop a proposal for subdivisions of the conservation zones with associated costs to give to managers for consideration in future years. We need to consider budget fluctuations over time and develop a design that can accommodate low budget years.

<u>Sampling Units</u>

Spatial definition of a primary sampling unit (PSU). Roughly rectangular area the length of which is ~20 km of coast line and the width of which is the distance between the inshore/offshore boundaries for the target population for a particular area. These PSUs meet end to end without any gaps along shore. The near shore boundary for each PSU will be recorded Each PSU represents a cluster consisting of two subunits, one being near shore and one being offshore. (Note this replaced earlier discussions about having two strata, one inshore and one offshore). Ken Ostrom will work with the researchers and develop a map of these PSUs for each conservation zone. Once defined, the PSUs will be fixed for the duration of the Program.

Temporal definition of PSU. Approximately a half day's effort to avoid splitting a primary sampling unit over two days and to allow for other difficulties (weather, mechanical, etc.).

Method of selecting PSUs. Random without replacement. Randomly select all the areas in advance and to the maximum extent possible try to spread out efforts geographically and temporally (within reasonable logistic constraints). Each researcher discussed how they would spread effort out over time and space given the number of PSUs within each conservation zone and within the geographic strata. Everyone will provide a summary of how they will do this which will be incorporated into the Program using maps to generally illustrate PSUs and their selection during the course of a field season.

Number of PSUs sampled per zone. Approximately 30. Derived from approximately 60 days (two months) of sampling time counting weekdays only and allowing for weather and mechanical difficulties. If we can do more in each zone, we will (as long as all the samples are chosen in the same random way).

Method of subsampling PSUs. Methods will differ within the two subunits of a PSU. Within the near shore subunit, four 5-km segments parallel to shore will be chosen at random distances from shore. Those distances will be chosen in increments of 100 meters beginning at 50 meters from the inshore boundary (eg., 250m, 350, 450, etc. for an inshore boundary starting at 200m). Within the offshore subunit of the PSU, a zigzag transect will be run at random starting points from shore in increments of 100 meters. The zigzag transect will cover the entire length and width of the offshore subunit. The exception to having zigzag transects in the offshore subunit will be around the convoluted shorelines of the islands of Puget Sound where parallel transects will be used.

Transects will be placed to avoid overlapping sampling effort within the two subunits of a PSU.

A figure will illustrate this in the Program. Using an example of a PSU with a width of 300m-3000m with a subunit boundary at 1500m, would mean randomly choosing inshore parallel transects from possible distances of 350m, 450m, 550m, 650m, 750m, 850m, 950m, 1050m, 1150m, 1250m, 1350m, and 1450m with the zigzag transect starting at a possible distance of 1550m, 1650m, 1750m, etc., and bouncing between 1550 and 2950m.

Q: How do we allocate the length of transect per subunit of PSU?

$$\textbf{Proportion of Length} = \frac{a_1\sqrt{\lambda_1}}{a_1\sqrt{\lambda_1} + a_2\sqrt{\lambda_2}}$$

where a is area of subunit and lambda is density.

NOTE: In a discussion with TM after the meeting, he noted that it would likely be preferable to select our parallel transects in the inshore subunit in some kind of restricted random manner to ensure we are spreading our 4 transects out spatially from shore. Using our above example of an inshore subunit from 300m-1500m gives you 12 distances from which to choose. You could divide those 12 distances into four groups of three transect distances each (eg., one group would be 350m, 450m and 550m). Then you randomly select one of those three distances from each of the four groupings for your four 5-km transects. That way, you’ve covered the "width" of the inshore subunit fairly well in each PSU. This will be a topic for future discussion, but it would be really good to have this settled in time for this field season.

Method of selecting PSUs between years. The group deferred this discussion. It doesn’t look like it will be a difficult issue to deal with since we have a finite number of PSUs from which to select.

ANALYSIS/DATA MANAGEMENT

Level of Precision

We can make a rough attempt at precision, but will be in a much better position after one year of sampling to refine it. This will tell us whether we need to increase the sample size in future years. For precision, JB encourages the group to think in terms of birds per square kilometer plus or minus some number of birds as well as thinking about percentages.

Distance Program

Everyone is using the Distance Program. MR will put together a template of Distance steps for the group to review and share with Jeff Laake. For our density estimates we would use the actual distance traveled weighted by the area of the PSU.

$$\hat{\lambda} = \frac{a_1 \hat{\lambda}_1 + a_2 \hat{\lambda}_2}{a_1 + a_2}$$

We would obtain a detection function, density estimate and model per geographic strata. What do we do for small sample sizes? For example, what if CT gets too few detections in the South Coast Washington geographic strata? He can use the North Coast detection functions.

Data Management
Ultimately want to have a consolidation of data for a larger analysis. This can happen in a variety of ways, but we need to be thinking about it. All will send NB data forms plus an explanation of the fields within the next month. NB will consolidate the common fields for monitoring.

SURVEY METHODS
Number of Observers
MR gave an overview of his methods and results comparing one with two observers. Using an independent observer, he compared the percentage of birds missed by a single observer (20%) to that missed by a pair of observers (16%) and found they were not significantly different (from Pacific Seabird Group abstract). Considering the costs of having extra observers, he advocated using single observers. CR and SM concurred.

TM feels this is a very complex test and the analyses done to date may be too simplistic. Its not as simple and straight forward as it appears. CT concurred and discussed their difficulties with basically the same design used during the boat avoidance study. For example, some animals are more visible than others and therefore more likely to be sampled. Their analysis became extremely complex and hasn't been completed yet. Kirsten Brennan is working on this project (for her Master's) with Jeff Laake. MR noted that he asked for guidance early in the field season and his design reflected those suggestions. MR asked for any information available from the boat avoidance study to help him with his analysis.

In light of these complexities, the team voted again. Two observers won the most votes, but it was not a consensus. We discussed again that this is a pilot year and we may address this issue in the future if we gain better information to help with this decision.

Methods of estimating distance of bird from transect line

MR gave an overview of his methods and results comparing: 1) estimating perpendicular distances of birds off the transect line versus 2) estimating distance of the bird from the boat and estimating the angle of the bird off the transect line. Both methods attempt to get an accurate distance of the bird from the transect line to obtain density estimates using the Distance Sampling method. He found it was slightly more precise to directly estimate the perpendicular distances.

The group discussed the advantages and disadvantages of both methods from the perspective of training and quality assurance/quality control. The group felt observers can be trained to use either method. From the QA/QC perspective, it is unlikely that we will be able to measure the accuracy of these measurements while surveys are underway no matter which method is chosen. The group voted and there was general consensus to estimate direct perpendicular distances of birds off the transect line.

Note: Some of the following topics will likely need further discussion since we were running out of time and some of our discussion was cursory (e.g., viewing conditions, training and productivity).

<u>Crew Switcheroo</u>
The group discussed some of the ways we can deal with observer variability. CR feels that observer variability can be greater than a lot of the other sources of variability we've been trying to deal with. Some observers seem to never miss a bird while others do. We talked about the training program which will define target standards for observers as part of the solution. But that doesn't address missing birds altogether. CR suggests encouraging interchange of crew members between areas to spread out these effects. This was adopted as long as it doesn't incur additional travel costs, etc.

<u>Boat Size and Speed</u>
There are size differences among the boats (but unfortunately no one is offering to buy us a new fleet of boats). CR felt the most important aspect is likely to be the height of the observer which will be a field in the data sheets. The boat speed is ~8-12 knots. Recommend boats go slower as viewing conditions deteriorate.

<u>Viewing Conditions</u>
If visibility drops below 100m, recommend stop surveying. Wavelets are a concern because too many in the observers' view becomes confusing. When wavelets are closer than 50m, recommend stop surveying.

<u>Training</u>
The training portion of the Program will include such parameters as percentage of birds correctly identified, distance estimates within certain acceptable levels, percentage of birds missed, etc. For example observers will be tested to be within ± 25% of true perpendicular distances 90% of the time.

Time of Day
There seem to be large differences in number of birds seen as a function of time of day in some areas. For example, CT consistently sees more birds in the morning. We discussed whether this was another source of variability we should try and account for in the temporal distribution of PSUs. Most felt it would not be possible to implement. In much of the survey area, the winds pick up in the afternoon to the point where surveys are impossible. Time of day will also be recorded.

Productivity
The team did not have enough time to adequately discuss this topic as it relates to Effectiveness Monitoring and decide whether it should be a part of the Program. This topic needs further discussion. It would be great to have good productivity information (ratio of young/adults), but it may be just as good to have good population counts every year depending on the reliability of productivity measures. If it is going to be a part of the Program, it will need to be measured in a standardized manner. It adds costs to the Program because it means surveying later into the season about 3 additional weeks.

Q: Can you reliably measure productivity? Not sure. Then it may still be a research issue. SM has several years of data that indicate very low productivity and thinks we should continue to gather data. MR notes productivity may point more the marine environment (prey available) than to the forest management conditions.

TO DO LIST
1. Naomi will type up notes and send to all by March 10.
2. Naomi will use these notes to develop a first draft of the Marbled Murrelet Population Monitoring Program by March 31 (so read these notes carefully and give me your corrections).
3. All will send Naomi data collection sheets with explanations of the fields by March 31.
4. Naomi will consolidate the common fields needed for monitoring.
5. All will send Naomi budget estimates for this sampling design.
6. Marty will put together a template of Distance steps.
7. All will write a paragraph on how you will spread samples over time and geographic strata.
8. All will work with Ken Ostrom and Naomi on start/end points of the PSUs
9. Once maps are constructed, all will show how they spread their samples over space and time on maps.

Summary Table of Sampling Design

Researcher and Recovery Zone	MR (1)	CT (1&2)	CS (3)	CJ/SM (4)	CJ/SM (5)	SB (6)
Target Population	Entire Zone 1 except Strait of Juan de Fuca	Strait of Juan de Fuca portion of Zone1, Entire Zone 2	Entire Zone 3	Entire Zone 4	Entire Zone 5	Entire Zone 6
Geographic Strata (maps in development)	1. San Juan Islands and selected portions of Puget Sound 2. The remainder of San Juan Islands and Puget Sound	1. Strait of Juan de Fuca 2. WA North Coast 3. WA South Coast 4. Grays Harbor, Willapa Bay and Columbia River	1. North portion of Zone 2. South portion of Zone	Entire Zone	1. North half of Zone 2. South half of Zone	1. Central portion of Zone 2. The remainder of the Zone
Primary Sampling Unit (PSU)	~20 km section of coast line with inshore and offshore subunits	~20 km section of coast line with inshore and offshore subunits	~20 km section of coast line with inshore and offshore subunits	~20 km section of coast line with inshore and offshore subunits	~20 km section of coast line with inshore and offshore subunits	~20 km section of coast line with inshore and offshore subunits
PSU Inshore/Offshore Subunits	1. Navigable waters-500 m 2. 500-2000 m	1. Navigable waters-1500 m 2a. 1500-5000 m (strata 1 and 2) 2b. 1500-8000 m (strata 3)	1. Navigable waters-1500 m 2. 1500 to 5000 m	1. Navigable waters-1500 m 2. 1500-3000m	1. Navigable waters-1500 m 2. 1500-3000 m	1. Navigable waters-1500 m 2. 1500-3000 m
PSU Selection (maps in development)	Random selection without replacement within each geographic strata and spread over time and space to the maximum extent feasible logistically	Random selection without replacement within each geographic strata and spread over time and space to the maximum extent feasible logistically	Random selection without replacement within each geographic strata and spread over time and space to the maximum extent feasible logistically	Random selection without replacement within each geographic strata and spread over time and space to the maximum extent feasible logistically	Random selection without replacement within each geographic strata and spread over time and space to the maximum extent feasible logistically	Random selection without replacement within each geographic strata and spread over time and space to the maximum extent feasible logistically

Researcher and Recovery Zone	MR (1)	CT (1&2)	CS (3)	CJ/SM (4)	CJ/SM (5)	SB (6)
Sample Size of PSUs per Season (n) (and by above Geographic Strata)	~25 (1. ~20 2. ~5)	~35 (1. ~5 2. ~21 3. ~6 4. ~3)	~30 (1. ~8 2. ~20)	~40	~20 (1. ~15 2. ~5)	~30 (1. ~25 2. ~5)
Total PSUs (and Per Geographic Strata)	~86 (1. 26 2. ~60)	~22 (1. 7 2. 6 3. 6 4. 3)	~17 (1. 7 2. 10)	~20	~12 (1. 7 2. 5)	~9 (1. 4 2. 5)
PSU Subsampling	Four 5-Km parallel transects in inshore subunit, parallel offshore	Four 5-Km parallel transects in inshore subunit, zigzag offshore	Four 5-Km parallel transects in inshore subunit, zigzag offshore	Four 5-Km parallel transects in inshore subunit, zigzag offshore	Four 5-Km parallel transects in inshore subunit, zigzag offshore	Four 5-Km parallel transects in inshore subunit, zigzag offshore
Time of Year	Mid-May to mid-July	Mid-May to mid-July	Mid-May to end of July	Mid-May to end of July	Mid-May to end of July	Mid-May to end of July